alternate bendings in opposite directions, according as one or other of the components is temporarily the stronger.

iii. Wiesner allows that circumnutation does exist in some cases. This last class he considers a small one; he states, indeed, that "nearly all, especially the clearly perceptible circumnutations," are combined movements belonging to the second of the above categories.

Although I have perhaps no right to such an opinion without repeating Wiesner's work, yet I must confess that I cannot give up the belief that circumnutation is a widely-spread phenomenon, even though it may not be so general as we supposed.

If, then, circumnutation is of any importance, we are forced to ask what is its relation to growth-curvatures. It was considered by my father to be "the basis or groundwork for the acquirement, according to the requirements of the plant, of the most diversified movements" ("Power of Movement," p. 3). He also wrote (*loc. cit.*, p. 4):—"A considerable difficulty in the way of evolution is in part removed, for it might be asked how did all these diversified movements . . . . first arise? As the case stands, we know that there is always movement in progress, and its amplitude, direction, or both, have only to be modified for the good of the plant in relation to internal or external stimuli."

Those who have no belief in the importance of circumnutation, and who hold that movements may have arisen without any such basis, may doubtless be justified in their position. I quite agree that movement *might* be developed without circumnutation having anything to do with the matter. But in seeking the origin of growth-curvatures it is surely rational to look for a widely-spread movement existing in varying degrees. This, as I believe, we have in circumnutation: and here comes in what seems to me to be characteristic of the evolution of a quality such as movement. In the evolution of structure, each individual represents merely a single one of the units on which selection acts. But an individual which executes a number of movements (which may be purposeless) supplies in itself the material out of which various adapted movements may arise. I do not wish to imply that tentative movements are of the same order of importance as variations, but they are undoubtedly of importance as indication of variability.

The problem may be taken back a stage further; we may ask why circumnutation should exist. In the "Power of Movement" (p. 546) we wrote:—"Why every part of a plant whilst it is growing, and in some cases after growth has ceased, should have its cells rendered more turgescent and its cell-walls more extensile first on one side then on another . . . is not known. It would appear as if the changes in the cells required periods of rest." Such periods of comparative rest are fairly harmonious with any theory of growth; it is quite conceivable by intussusceptionists and appositionists alike that the two stages of elongation and fixation should go on alternately,[1] but this would not necessarily lead to circumnutation. It might simply result in a confused struggle of cells, in some of which extension, in others elongation, was in the ascendant; but such a plan would be an awkward arrangement, since each cell would hinder or be hindered by its neighbour. Perfection of growth could only be attained when groups of contiguous cells agreed to work together in gangs—that is, to pass through similar stages of growth synchronously. Then, if the different gangs were in harmony, each cell would have fair play, elongation would proceed equally all round, and the result would be circumnutation.[2] Whether or no any such origin of circumnutation as is here sketched may be conceived, there can be no doubt that it had its origin in the laws of growth apart from its possible utilization as a basis for growth-curvature.

It is, however, possible to look at it from a somewhat different point of view—namely, in connection with what Vöchting has called *rectipetality* ("Die Bewegung der Blüthen und Früchte," 1882). He made out the fact that when an organ has been allowed to curve geotropically, heliotropically, &c., and is then removed from further stimulation by being placed on the klinostat, it becomes straight again. This fact suggested to Vöchting his conception of rectipetality, a regulating power leading to growth in a straight line. It may be objected that such a power is nothing more than the heredity, which moulds the embryo into the likeness of its parent, and by a similar power insists that the shoot or root shall take on the straight form necessary to its specific character. But the two cases are not identical. The essence of rectipetality is the power of recovering from disturbance caused by external circumstances. When an organ has been growing more quickly on one side than another, the regulating power reverses this state of things and brings the curving organ back towards the starting-point. We have no means of knowing how this regulating power acts in undisturbed growth. It is possible to imagine a type of irritability which would insure growth being absolutely straight, but it is far more easy to conceive growth as normally made up of slight departures from a straight line, constantly corrected. In drawing a line with a pencil, or in walking towards a given point, we execute an approximately straight line by a series of corrections. If we may judge in such a manner by our own experience, it is far more conceivable that the plant should perceive the fact that it is not growing absolutely straight, and correct itself, than that it should have a mysterious power of growing as if its free end were guided by an external force along a straight-edge. The essence of the matter is this: we know from experiments that a power exists of correcting excessive unilateral growth artificially produced; is it not probable that normal growth is similarly kept in an approximately straight line by a series of aberrations and corrections? If this is so, circumnutation and rectipetality would be different aspects of the same thing.

This would have one interesting corollary: if we fix our attention on the regulating power instead of on the visible departures from the straight line, it is clear that we can imagine an irritability to internal growth-changes existing in varying intensities. With great irritability very small departures from the straight line would be corrected. With a lower irritability the aberrations would be greater before they are corrected. In one case the visible movement of circumnutation would be very small, in the other case large, but the two processes would be the same. The small irregular lateral curvatures which Wiesner allows to exist would therefore be practically of the same value as regular circumnutation, which he considers comparatively rare.

The relation between rectipetality and circumnutation may be exemplified by an illustration which I have sometimes made use of in lecturing on this point. A skilful bicycle-rider runs very straight, the deviations from the desired course are comparatively small; whereas a beginner "wobbles" or deviates much. But the deviations are of the same nature; both are symptoms of the regulating power of the rider.

We may carry the analogy one step further: just as growth-curvature is the continuance or exaggeration of a nutation in a definite direction, so when the rider curves in his course he does so by wilful exaggeration of a "wobble."

It may be said that circumnutation is here reduced to the rank of an accidental deviation from the right line. But this does not seem necessarily the case. A bicycle cannot be ridden at all unless it can "wobble," as every rider knows who has allowed his wheel to run into a frozen rut. In the same way it is possible that some degree of circumnutation is correlated with growth in the manner suggested above, owing to the need of regular pauses in growth. Rectipetality would thus be a power by which irregularities, inherent in growth, are reduced to order and made subservient to rectilinear growth. Circumnutation would be the outward and visible sign of the process.

I feel that some apology is due from me to my hearers for the introduction of so much speculative matter. It may, however, have one good result, for it shows how difficult is the problem of growth-curvature, and how much room there still is for work in this field of research.

NOTES.

THE German Leopold-Caroline Academy at Halle has conferred the degree of Doctor of Philosophy on the Director of the Royal Gardens, Kew.

MESSRS. MACMILLAN AND CO. hope to publish before Christmas a series of popular sketches in the history of astronomy from the earliest times to the present day, in the form of a

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[1] Strasburger, "Histolog Beiträge," p. 195, speaks of the pause that must occur after the formation of a cellulose lamella. Hofmeister, *Württemburg. Jahreshefte*, 1874, describes the growth in length of Spirogyra as made up of short intervals of rapid growth alternating with long pauses of slow growth.

[2] I purposely omit the circumnutation of pulvini.

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volume containing three courses of lectures on astronomical biography by Prof. Oliver Lodge, F.R.S. The work will be fully illustrated, and will bear the title "Pioneers of Science."

AT the monthly meeting of the Field Naturalists' Club of Victoria, held on July 13 last, as we learn from the Melbourne *Argus* of July 14, Messrs. Luehman and French read a note and exhibited the skin of a tree-climbing kangaroo from Northern Queensland, new to science, to which they gave the name of *Dendrolagus muelleri*. This remarkable marsupial has a body about two feet in length, with a tail somewhat exceeding two feet. The disproportion between the fore legs and the hind legs is not nearly so great as that of the ordinary kangaroo and wallaby; the toes are strong and curved, to enable it to climb tall and straight trees, on the leaves of which it exists. This tree-kangaroo is more nearly allied to the species which was discovered a few years ago in Queensland than to the two species from New Guinea. The specimen described was got from a straight tree, about ninety feet above the ground.

IN his letter on "Dredging Products" (NATURE, August 13, p. 344), Mr. Alex. Meek, writing from Shetland, gave a short *résumé* of localities where Actinotrocha has been found. As the south coast of England was not mentioned, Mr. W. L. Calderwood writes to call attention to a paper by his predecessor at the M.B.A. Laboratory, Plymouth, Mr. G. C. Bourne, published in the Journal of the Marine Biological Association, vol. i., No. 1. After mentioning the occurrence of Tornaria, Mr. Bourne goes on to say:—"Actinotrocha, the larva of Phoronis, is common. . . . Several specimens of larval Amphioxus were taken in the tow-net towards the end of October." In vol. ii. No. 1, Mr. Garstang also has a note on the occurrence of the adult Phoronis. Actinotrocha has again appeared several times during the present summer.

M. IMFELD, the Swiss engineer, who has been engaged to examine the nature of the summit of Mont Blanc for the construction there of M. Janssen's proposed Observatory, recounts in a Zürich journal the difficulties he is experiencing in his preliminary survey. M. Imfeld is staying with eight workmen and two doctors at M. Vallot's Observatory, which has an altitude of 4400 metres, and thence they proceed daily to the summit, where they work for several hours a day in the endeavour to ascertain the depth of the snow for the purpose of getting the necessary foundation for the building. M. Eiffel has expressed the opinion that the construction of an Observatory will only be possible if the snow does not exceed a depth of 12 metres. M. Imfeld states that they have encountered traces of a ridge of rock 18 to 20 metres below the summit, and covered with about 1 metre of snow. They have therefore commenced to make a series of lateral tunnels on three sides, at a distance equal to 12 metres below the summit, to ascertain if the ridge extends to that height. Progress is necessarily slow. Most of the men are suffering from *mal de montagne*. Some, however, who are engaged at M. Vallot's cabin are able to work almost as long as in the valley, and they also eat and sleep well. In spite of two coke stoves, the thermometer of the cabin never rises above zero; even ink freezes, and water boils at 83°, and they cannot properly cook meat. For a day or two they were disturbed by violent storms.

MARTINIQUE has been visited by a terrible cyclone, the most violent that has been known in the island since 1817. It lasted four hours, and was followed by an earthquake; and many lives were lost. According to the latest information received in Paris from Martinique on Monday last, the number of persons known to have perished was 340; but that did not include the sailors lost in numerous shipwrecks along the coast and at sea. Besides the persons killed, very many were injured by the falling buildings, trees, and stones. All along the coast houses were completely demolished. The town of Morne Rouge is said to be a total wreck, and Fort de France is almost entirely destroyed. Much suffering prevails among the population.

MESSRS. L. REEVE AND CO. have in preparation a new work on the British Fungi, Phycomycetes, and Ustilagineæ, by George Massee, Lecturer on Botany for the London Society for the Extension of University Teaching; a work on the British Hemiptera Heteroptera, by Edward Saunders; a new work on the Lepidoptera of the British Islands, by Charles G. Barrett; and a new work on the physiology of the Invertebrata, by Dr. A. B. Griffiths.

MESSRS. WHITTAKER AND CO. are about to publish "A First Book of Electricity and Magnetism," by W. Perren Maycock. The work is intended for the use of elementary science and art and engineering students, and general readers.

MESSRS. CASSELL AND CO. are issuing, in monthly parts, a new and revised edition of Sir R. Stawell Ball's well-known "Story of the Heavens." The first part has just been published.

THE additions to the Zoological Society's Gardens during the past week include a Common Fox (*Canis vulpes*), British, presented by Captain H. S. Tunnard; five White-eared Conures (*Conurus leucotis*) from Brazil, presented by Mrs. Arthur Smithers; four Leopard Tortoises (*Testudo pardalis*), three Angulated Tortoises (*Chersina angulata*), a Galeated Pentonyx (*Pelomedusa galeata*), a Hoary Snake (*Coronella cana*), a Robben Island Snake (*Coronella phocarum*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; two Alligators (*Alligator mississippiensis*) from Carolina, presented by Mr. Charles Downs; a Gold Pheasant (*Thaumalea picta* ♀) from China, presented by Mr. R. Hudson; a Pig-tailed Monkey (*Macacus nemestrinus* ♂) from Java, two Water Vipers (*Cenchris piscivora*) from North America, deposited.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 17.—M. Duchartre in the chair.—On a new blow-pipe, by M. Paquelin.—On "cyclic systems," by M. A. Ribaucour.—New researches on the solar atmosphere, by M. H. Deslandres. (See Our Astronomical Column.)—On the enormous velocity of a solar prominence observed on June 17, 1891, by M. Jules Fényi. M. Trouvelot has previously recorded a remarkable luminous outburst that occurred on the sun on June 17. The position-angle of the group of prominences observed by M. Fényi was about 282°. At one time the velocity of one portion of the group reached the high value of about 850 kilometres per second. And another portion was elevated through about 72′ 2″ in 210 seconds—the mean velocity being at least 485 kilometres per second. It is therefore concluded from the observations that matter can be projected from the sun into space with a velocity sufficient to prevent its falling back again.—Mechanical determination of the series of atoms of carbon in organic compounds, by M. G. Hinrichs.—On the arterial system of Isopods, by M. A. Schneider.—On the growth of the shell of *Helix aspersa*, by M. Moynier de Villepoix.

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